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Research in Small Countries

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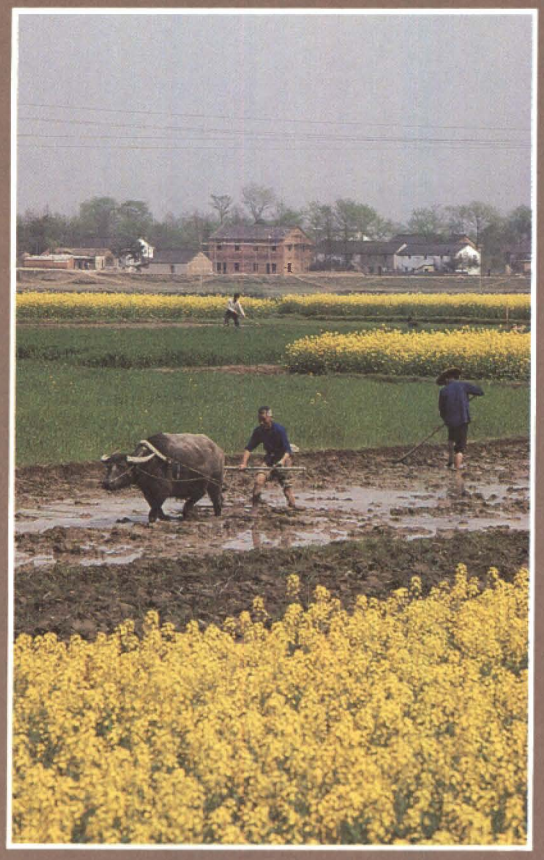


INTRODUCTION

Increasingly, evidence mounts that the most critical single obstacle to development is the widespread incidence of "absolute poverty." Moreover, the case can be made that the most effective tools to overcome that obstacle are those of science and technology.

Such an analysis of cause and cure is likely correct for each one of the more than one hundred nations desperately endeavouring to raise the social and economic standards of their peoples. Again and again, absolute poverty is being identified as the most significant barrier to development. It is a circumstance that spawns illiteracy, malnutrition, and pervasive unemployment. Absolute poverty contributes as well to environmental degradation. The World Commission on Environment and Development (the Brundtland Commission) reported last spring that "Those who are poor and hungry will often destroy their immediate environment in order to survive. They will cut down forests; their livestock will overgraze grasslands; they will overuse marginal land; and in growing numbers they will crowd into congested cities . . . . A world in which poverty and inequity are endemic will always be prone to ecological and other crises."

The effectiveness of science and technology as a means of solving developmental problems was emphasized by an earlier world commission, chaired by Lester B. Pearson, former Prime Minister of Canada. In 1969, that commission stressed that the developing countries must "select those areas where science can make its greatest

A scientist at the Laboratorio de Entrenamiento Multidisciplinario para la Investigación Tecnológica (LEMIT) research centre in Argentina explains cast-iron foundry technology to IDRC's President Ivan L. Head (left).

developmental contribution, . . . choose the most suitable technology, and . . . concentrate their resources in a coherent science policy that is reflected in education and training as well as in research." One of the outcomes of the Pearson Commission was the creation in 1970 by the Parliament of Canada of IDRC, the first organization in the world created specifically to assist developing countries to perform research and to enhance their own scientific and technological competence. In 1987, a report to the Swedish Parliament stated that "The establishment of IDRC can be regarded as the most significant initiative taken by any industrialized country to support research in developing countries."

Important as is the recognition of absolute poverty as the basic development problem (not simply as a manifestation of underdevelopment), and helpful as is the acknowledgment of the contribution of science and technology to solving the problem, the challenges facing decision-makers and scientists remain daunting as they endeavour to match resource supply and demand. Nowhere is this more evident than in the 32 independent countries with a population of less than 750 000 each. In these nations, financial and human resources are insufficient to build and staff the facilities required to conduct adequately the research needed to solve problems. Even in those instances where national universities have been created, these cannot be expected to demonstrate either the breadth of interest or the depth of ability required to tackle simultaneously the multitude of issues pressing upon the communities they serve. Other, often regional, solutions must be designed; so must networks and a variety of linkages among developing countries themselves.

Some of the material that follows endeavours to cast light upon this "smaller country" problem. Statistics do not always reveal the particular difficulties faced by these countries. Although science and technology in developing countries world wide have increased immensely in the 17 years since IDRC was created (from about 3% of total world expenditure on research and development in 1970 to 6% in 1982), this increment has not fallen evenly. Larger countries, such as India and Brazil, account for a much larger share of that percentage gain than do tiny countries such as St Lucia or Comoros.

The absence of a functioning university does not eliminate the possibility of research funding from IDRC or other organizations, but some kind of capacity to undertake methodologically sound investigations must be present. How to develop that capacity is a task attracting increased attention from the Centre. Of increasing concern as well are those research activities designed to enhance the skills of entrepreneurs in a range of technological endeavours that, in countries big and small, create employment opportunities and, in turn, increase the real demand for agricultural and other commodities. It is in this way that economies burgeon and societies develop.

An example of that kind of activity, research in a local sector demanding considerable technological knowledge and skill, is illustrated in the photograph (on the previous page). Work of that kind demonstrates that in this age of highly competitive global-scale activities, there remain many instances where comparative advantage favours the small, local enterprise. This advantage is found in countries of all sizes and, in the result, is of benefit to countries both developing and developed. This is good news in an era where our interdependence demands that we must all benefit, or we will all suffer.

Ivan L. Head
President, IDRC

What is IDRC?

The International Development Research Centre (IDRC) is a corporation created by the Parliament of Canada in 1970 to stimulate and support scientific and technical research by developing countries for their own benefit.

The fields of investigation to which IDRC gives its financial and professional support include farming; food storage, processing, and distribution; forestry; fisheries; animal sciences; energy; tropical diseases; water supply and sanitation; maternal and child health; education; population studies; economics; urban policies; science and technology policy; information systems; industrial engineering; earth sciences and building materials and techniques; and dissemination of research results.

Although IDRC is funded entirely by the Canadian Parliament, to which it reports annually, its operations are guided by an international 21-member Board of Governors. Under the IDRC Act, the chairman, the vice-chairman, and 9 other governors must be Canadian citizens; in practice, 7 of the remaining 10 governors are from developing countries.

The Centre's programs help developing countries to build the scientific competence of their institutions and their researchers so that these countries can work to solve their own problems. Opportunities are given to researchers to broaden their experience through practical work assignments or advanced studies.

IDRC emphasizes the role of the scientist in international development and encourages Third World countries to draw on the talent of their own scientific communities. Building a strong local base for future research is an important objective of most IDRC-supported work. Research projects are identified, designed, conducted, and managed by developing-country researchers in their own countries, to meet their own priorities.

IDRC helps to create and supports international research networks through which developing countries can learn from each other, share common experiences, and conduct similarly designed studies in areas of mutual concern. It also promotes cooperation between developing-country researchers and their counterparts in Canada through so-called cooperative projects. Up to last year, most projects in this category were managed by a single division. Now, all of IDRC's divisions can fund regular projects — conceived, realized, and managed by Third World scientists — as well as cooperative projects.

Cooperative Projects

Most of IDRC's funds are contributions to research conceived, managed, and done by Third World scientists. But the Centre also supports collaboration between scientists in developing countries and their counterparts in Canada — whether academic, governmental, or private. Cooperative projects can be in all research areas supported by IDRC (as listed at the beginning of this section) and in which there is recognized Canadian expertise.

Research Programs

Agriculture, Food and Nutrition Sciences — In this group of related sciences, emphasis is on farming systems, social forestry in arid and semi-arid lands, and aquaculture. Specific areas of support include previously neglected food sources such as root crops, food legumes, and

oilseeds; agroforestry (growing trees and crops together); multiple cropping systems; improvement of pasturelands; use of nonconventional feeds for animals; fish and shellfish farming; postproduction systems for the preservation, processing, and distribution of food crops, fruit, and fish; and the economics of small-scale farm production and marketing.

Health Sciences — The division's support is concentrated in five broad areas of applied research: health services, water supply and sanitation, maternal and child health, tropical and infectious diseases, and occupational and environmental health.

Social Sciences — Research supported by the division is designed to improve understanding of the social and economic issues related to international development, permitting researchers and policymakers to formulate policy options in several thematic areas. These include education, population, science and technology, energy, urban development, economics, and rural development. Support is also given to a limited number of national and regional institutions in the social sciences and to research on problems of special regional concern.

Earth and Engineering Sciences — This division supports research in three main areas. One program aims at helping small- and medium-scale enterprises in developing countries to create jobs. The Earth Sciences program focuses on hydrology, hydrogeology, geotechnics, and small-scale mining technologies. Shelter is the theme of a third program supporting research using local resources to develop improved low-cost construction materials and techniques.

Until last year, this division was exclusively managing IDRC's cooperative programs bringing together Third World and Canadian scientists. The division now funds regular projects — imagined, managed, and done by Third World scientists — as well as cooperative projects.

Information Programs

Information Sciences — Support given by the division helps developing countries to establish regional and national information systems and improve library infrastructures at these levels; participate in international information networks; create specialized information centres (serving the region or world) on development-related subjects; strengthen sectoral information programs, especially in agriculture, health, population, industry, the environment, cartography, and social issues; and develop information tools and methods. The division's computer systems group provides internal services and distributes MINISIS, a bibliographic software package designed by IDRC, to developing countries. In addition, a library and micrographics unit serve IDRC staff, the Canadian development community, and IDRC-supported projects.

Communications — Services provided by the division include the publication and dissemination of the results of IDRC-supported research via print and film media, public affairs, and translation. The division also aims at strengthening the ability of research institutions in developing countries to prepare and disseminate scientific and technical information, particularly on projects supported by IDRC.

Fellowships and Awards — The division funds the training of junior and senior Third World scientists, managers, and planners working in sectors covered by IDRC's program divisions. Preference is given to individuals from the least-developed countries and the emphasis is on professional upgrading rather than basic training. In addition, the division supports practical, nondegree, group training to improve technical, research, and administrative skills of individuals. A portion of the division's funds is also used to encourage the involvement of young Canadian researchers in scientific areas of concern to IDRC and to expose them to the

Traditional gourd carving in Peru — handicrafts are an important source of income in most developing countries.

problems of the developing world. These doctoral students are posted to a Third World country for studies, research, or placement.

Funding and Selection of Projects

Each program division channels funds to institutions in developing countries (government departments, universities, research centres, etc.), to international and regional institutions, and to Canadian institutions. The recipient is expected to pay a portion of the costs.

All projects are reviewed by IDRC's professional staff and assessed in light of factors such as

- Development priority: Is the proposal consistent with national or regional development goals?
- Regional applicability: Are the research findings likely to be applicable in developing countries or regions other than the one in which the research takes place?
- Usefulness: Will the research help close gaps in living standards or lessen the imbalance in development between rural and urban areas?
- Local resources: Will the project make full use of local resources and research workers from the region?
- Training: Will the project result in better trained and more experienced researchers and more effective research institutions?
- Research area: Does the research fall within IDRC's areas of concentration?

When IDRC agrees to support a project, it enters into an agreement with the developing-country institution. In it are stipulated the project's purpose, research methods, payments, and a

schedule for the research and progress reports.

The Program Officer

Although IDRC itself rarely undertakes research, its program officers are highly qualified professionals. One of their main functions is to respond to project ideas proposed by developing-country researchers and to evaluate the suitability of proposals in light of the criteria stated earlier.

Once a project has been approved in principle, the program officers collaborate with the institution submitting the proposal in further refining the project idea, provide administrative and technical advice, and help in preparing a project budget. Program officers are based either at IDRC headquarters in Ottawa or in one of the regional offices. In the regions, they help determine research priorities and prepare detailed annual plans of projects to be defined and developed, workshops and seminars to be organized, and maintain contact with research institutions throughout the region.

Project Approval

Before funds are appropriated, a project proposal must go through a formal approval process.

Authority to approve projects for which funding exceeds $100 000 lies with IDRC's Board of Governors. It delegates approval authority to the President and the Vice-Presidents for projects up to $100 000, to Directors of individual divisions for projects up to $50 000, and to Deputy Directors for projects up to $15 000.

When a project has been approved, funds are appropriated by the Office of the Treasurer. The Secretary's Office prepares a Memorandum of Grant Conditions (MGC) governing all aspects of the relationship between the signing parties. Once the MGC has been signed by the recipient, funds can be forwarded.

R&D IN SMALL COUNTRIES

This introductory section focuses on the situation and particular problems faced by small developing countries (with a population of less than 10 million) in research and development (R&D) activities. Decisions on the level and direction of allocation of resources to research are, of course, those of the countries themselves. Nevertheless, an organization funding research in these countries has an interest in understanding the options so that its own decisions on the level and type of activity to support make the best possible contribution to strengthening national endeavours.

The contribution that R&D makes to the development process is widely accepted as vital. This process implies access to new knowledge and new ways of embodying and exploiting existing knowledge. The particular circumstances in which small countries gain access to existing knowledge, adapt it to their specific purposes, or contribute to generating new knowledge are part of an extremely complex global system of relations. The extent to which research can contribute depends on the level of resources (funds and staff for research) and the allocation of scarce resources to a multitude of needs; this goes hand in hand with the necessity to look at what mechanisms are most productive when the resources are as limited as they are in small-country cases.

The research "system" (really a misnomer because activities lack the interconnectedness that this implies) thought appropriate for a particular country will depend on its resource endowment and the development objectives and strategy. This gives rise to a vast range of different, individual situations and sets of choices for decision-makers. There are, however, some common considerations that deserve highlighting. One possible assumption is that small countries will have limitations in terms of potential economic size so severe that their development options will be significantly different from larger countries.

This section begins to explore whether there are also significant limiting factors in the type and level of R&D that can be economically justified. In many areas of research, a certain minimum critical mass is required in terms of human and financial resources before R&D can be productive. The low level of resources that small countries can devote to R&D may mean that the input required to achieve even this minimum is beyond their means. There is an additional economic argument that suggests that production-related research in small countries is likely to be more expensive per unit of production than in larger countries — the research costs required on a crop that is grown on 50 000 ha in one country and 150 000 ha in another may *not* vary greatly; the research cost per hectare under production will be quite different.

How Many Small Countries?

Clearly, any definition of "small countries" is arbitrary and depends on the issue or problem being investigated. The imprecision of the term requires a definition each time "small" is the focus. The principal criterion used here for labeling small countries is that of population. This also serves as a reminder that the richer industrialized countries with relatively small populations face particular problems of R&D strategy as well.

Studies of "small countries" have proliferated because many countries that

have gained independence in the last 30 or so years belong in this category. Various reports have shown a general congruence between population size and other measures of size although not a clear correlation. A more detailed assessment of criteria would be necessary to classify individual countries, but this is not necessary for this review. We will use only the criterion of population size, recognizing that some countries with a small population may well have other elements that make some of the limiting factors less relevant. Depending on particular studies, the cut-off population size used varies between 5 and 10 million; here, 10 million has been selected as the upper limit to the category.

What numbers are included in our category? Table 1 shows that in 1985 about 67% of all developing countries (used here interchangeably with "Third World countries") had a population of less than 10 million and 52% less than 5 million. The gross national product (GNP) of all but five of the 77 small countries for which there are data is under US $10 billion. Sixty-six of these countries have a GNP below the US $5 billion mark. (World Bank and other internationally available data on GNP and R&D have been kept in US dollars.)

One consistent finding is that there is no relation between country size and GNP per capita. Smaller countries do not necessarily have lower per capita incomes. A growing literature now studies the relationship between country size and economic performance — some figures suggest that small countries exhibit wider growth rate fluctuations and have tended to experience recession more severely, but the evidence is far from conclusive. Other studies relate size and the distribution of imports and exports as a percentage of GNP; these suggest that imports and exports account for a greater percentage in smaller countries, with a consequently greater degree of dependence on international markets. So there appear to be some distinguishing features in economic development characteristics, although the evidence is preliminary. Are there distinguishing features in their research systems and potential?

Developing-Country Research

The access of small developing countries to the outputs of R&D — their own and others' — is crucial to their

Table 1. Country size and gross national product (GNP) in developing countries, 1985 (US $ billion).

Population (million)	GNP					Total
	Less than 1	1–5	5–10	More than 10	No GNP data	
0–10						
0–1	21	10	1	—	4	36
1–5	5	17	2	4	3	31
5–10	—	13	3	1	1	18
Sub total	26	40	6	5	8	85
More than 10						
10–20	—	3	5	5	4	17
More than 20	—	1	5	16	3	25
Total	26	44	16	26	15	127

Note: Intervals are rounded. 1 United States dollar (US $) = 1.33 Canadian dollars (CA $).
Source: World Bank Atlas, 1987.

Table 2. Research and development (R&D) expenditures by developed and developing countries, 1980 and 1984.

R&D expenditure (US $ billion)		Percentage share		
		R&D	GNP	Population
Global 1980	**207.8**			
Developed	194.9	94	79	19
Developing	12.9	6	21	81
Global 1984	**240.0**			
Developed	226.0	94	79	21
Developing	14.0	6	21	79
OECD 1984	**189.8**			
USA	98.1	52	44	29
Top 5	167.2	88	78	66
Bottom 5	0.5	<1	1	4
Countries less than 5 million population (6 total)	2.4	1	2	3
Countries less than 10 million population (12 total)	6.8	4	6	8
Third World (1980)	**12.9**			
Sub-Saharan Africa	0.8	6	8	11
Arab States	1.0	8	24	7
Latin America	3.9	30	31	11
Asia	7.2	56	37	71

Note: 1 United States dollar (US $) = 1.33 Canadian dollars (CA $). Percentages have been rounded.
Sources: Unesco 1985 Statistical Yearbook; *OECD Observer*, 1986; and IDRC internal documents.

development and their level of activities in this area is low even as a percentage of their limited resources. There are two important observations: first, the level of R&D activity in the Third World is low in comparison to the industrialized countries; second, much of this R&D is concentrated in the larger developing countries (e.g., Argentina, Brazil, China, India, Korea, and Mexico).

Global and national figures of expenditures on R&D are still extremely unreliable. The best estimates available indicate that global R&D expenditures for 1984 were some US $240 billion with the Third World accounting for 6% of the total or US $14 billion (Table 2). (These total figures include, of course, the considerable expenditure of a number of industrialized countries on defence research.) The developing countries' share of the world GNP is 21% with about 79% of the world population. As mentioned earlier, within the developing countries group, there are marked regional and country disparities. Using data for 1980, there is a clear concentration of R&D effort in Asia with 56% of total developing-country R&D expenditure followed by Latin America with 30%. Within regions, there is an even sharper contrast between countries. Nigeria accounts for 50% of sub-Saharan Africa's research effort (excluding the Republic of South Africa). In Asia, China is responsible for an estimated 40% of the regional total. Similarly, Brazil alone was responsible for 50% of the R&D effort in Latin America, and Argentina and Mexico raise the level of concentration to 77% of the regional total. What this means is that about US $8–9 billion of developing-

country R&D expenditure of US $14 billion is accounted for by eight countries.

The OECD Case

This is not so different from the industrialized countries. In the Organisation for Economic Cooperation and Development (OECD) group of 24 industrialized countries, the largest five countries account for 88% of the total OECD expenditure on R&D. The head of the science and technology (S&T) indicators unit of OECD reported that the "second" five countries, which include Canada, spent a further 10% of all resources devoted to R&D in the OECD area and added "then there is a set of smaller countries spending 1–2%. This shows very clearly that research is an extremely concentrated activity and that for most countries the problem is not so much to *undertake research, but to gain access to research from elsewhere*" (emphasis added). These 14 smaller OECD countries nevertheless account for a total research budget of between US $2 and $4 billion (an average of US $140–280 million/country).

The OECD has considered the problem of "smallness" (in this case, defined by GNP) in relation to S&T policy and economic growth in its small member countries. Different industrial strategies have been suggested (e.g., finding niches in the market, cooperating with other countries, and specializing) requiring different R&D strategies to support them. These countries face the problem of not having big enough domestic markets to generate competitive economies of scale or, in some cases, to pay back R&D costs. Academic studies have proposed general guidelines for the identification of areas where small industrialized countries might establish relatively large R&D programs:

- Areas where it is important for the small country to pursue an indigenous R&D effort to meet its social and economic objectives;
- Areas where current R&D makes it natural to establish "axes of penetration";
- Areas in keeping with the small country's R&D capability regarding cost, workforce, type of activity, and field of science and technology; and
- Areas useful to a strategy for strengthening the small country's position relative to the international division of labour.

Size is mentioned as a specific factor limiting the scope of activities and requiring careful allocation of available resources in several OECD reviews of national science policy: for Iceland ". . . given its smallness and given that its competitors base their economic performance in large measure upon their ability to harness their own scientific and technological strengths, Iceland cannot afford not to have a clear science policy" and Norway "when discussing the features specific to their [S&T] system, Norwegians usually begin by saying quietly, with a hint of reserve — Norway is a small country. The examiners reporting on social sciences policy in Norway heard the same comment from nearly everyone they spoke to and added that the size of a country necessarily limits the range of research fields open to it and makes choices harder."

R&D in Small Developing Countries

This reference to the OECD experience underlines that small *developing* countries are not alone in having to make tough R&D decisions and to limit the areas in which they can build R&D capacity. The resource constraint is always present (indeed even for the larger industrialized countries) but it does "bind" at different levels. The situation of the small developing countries is difficult to describe in detail given the absence of reliable country data. Notwithstanding the relative weakness of the R&D effort, it is important to enumerate reasonably accurately the level

Table 3. Financial and human resources in R&D — estimates for selected developing countries.

Country	Population mid-1985 (million)	R&D budget: Total R&D (US $ million)	R&D budget: Percentage of GNP	Number of researchers	Sectoral funding focus (%)
Botswana	1.1	4.3 (1984/85)	0.4	235	Agriculture 75 Technology and energy 23
Costa Rica	2.6	5.2 (1981)	0.2	850	Agriculture 46 Social development 19 Health 15
Guatemala	8.0	14.8 (1983)	0.2	1094	Energy and industry 29 Agriculture 22
Honduras	4.4	9.2 (1985)	0.1	612	Agriculture 76 Social development 11 Health 9
Jordan	3.5	4.2 (1984)	0.1	1472	Industry, natural resources, and construction 42 Agriculture 21 Humanities 17
Malawi	7.0	4.5 (1984)	0.4	477	Agriculture 96
Mauritius	1.0	4.3 (1985/86)	0.4	263	Agriculture 94
Singapore	2.6	100.6 (1984/85)	0.6	2401	Engineering and technology 72 Medical sciences 13 Natural sciences 10
St Lucia	0.1	1.2 (1985)	0.7	27	Agriculture and environment 75 Health 25
Trinidad & Tobago	1.2	19.0 (1985)	0.3	186	Agriculture 49 Energy and industry 38 Marine and environmental 13

Note: 1 United States dollar (US $) = 1.33 Canadian dollars (CA $).
Source: Data obtained from national surveys and country studies undertaken for IDRC by local researchers.

of resources devoted to R&D and their sectoral concentration. It seems likely that even the cost of collection of information on resources devoted to research is more expensive per researcher or research institution in smaller research "systems."

Table 3 shows information on the R&D resources of a number of small developing countries from different regions of the world. In most cases, these come from studies of national research systems undertaken for IDRC by local researchers — but even these studies relied for the most part on existing, although sometimes difficult to access, information. In other cases, where studies were started with no existing information, reports have still to be submitted. A number of these cases are also illustrated by "boxes" in the text to give more feel for the context in which the allocation decisions of individual countries are made.

Most of the countries included in Table 3 have a relatively small number of institutions engaged in research, seldom more than 10, although each institution may contain several research units (e.g., departments or specialized centres within a university). In almost all cases, research is funded overwhelmingly from public funds; there is little private-sector research except where a parastatal institution is linked to a growers' interest group, usually in the case of an export crop such as sugar or coffee. Reliance on external support varies greatly depending on country and sector but can reach 50%.

Countries are typically devoting between 0.1 and 0.4% of their GNP to research. Several have targets to increase research to 1% of GNP (the major industrialized countries spend closer to 2%), but even these targets seem elusive in the foreseeable future.

Figures for the number of researchers, in most cases, vastly overstate the real time devoted to research, because it is only one of several functions performed by staff of scientific institutions, particularly universities. Indeed, a number of country studies suggest that with increased university enrollment, staff time devoted to research is decreasing. In 1980, for example, staff time allocated to research in the Faculty of Agriculture of the University of Jordan was on average 50% of the total available, whereas in 1984 it had fallen to 25%. During 1980–84, the number of students enrolled had doubled but professional staff had increased by only 20%. Country studies also comment on the need to take greater advantage of the research resource offered by universities and to link them into the national research effort, particularly in view of the overall shortage of resources and the wide range of issues requiring research.

The S&T issues facing small developing countries are complex; they are attempting to meet domestic economic and social needs, for which they require a contribution from domestic S&T, but are doing so in an international environment that is undergoing rapid technological change and in which "conventional" wisdom is in question. One convention was that basic industrial activity (the "mature" industries) requiring low capital and high labour inputs would eventually shift to countries that have a comparative advantage in those factors of production. Concomitantly, industrialized countries would shift into high technology, capital-intensive productive activities. There is some feeling that what is happening does not follow this convention. Basic industrial activities are becoming more technologically intensive. Consequently, some industries expected gradually to decline in the industrial countries are now experiencing a "renaissance" and are the subject of considerable R&D effort.

What this means is that as the large countries invest more at this level of productive activity, it will raise the technological content of commodities and, thus, increase the threshold level of S&T activity in terms of the necessary supporting S&T infrastructure. There are important economies of scale in the production of many major consumer goods. These may present major barriers to starting production except where countries can identify particular "niches" in the range of productive activities. It is also likely that the threshold level of capital to invest in R&D on industrial

In Swaziland, a veterinary scientist examines a goat for fleas, which can be vectors of diseases.

activities is increasing for manufactured commodities, limiting the range of feasible goods (and research) for small countries' production. The implications of a changing international division of labour and of the complexity of commercial and investment decisions facing small countries argue in favour of their building some independent capacity to carry out research on policy (economic, S&T, etc.). They need to ensure that they have adequate access to external technical and marketing information and an ability to analyze this information in such a way that major policies and investment decisions are based on the best available knowledge.

The Agricultural Sector

But for many developing countries, large or small, agricultural research is the most important research sector. The issues of economies of scale, minimum critical mass, and the potential to tap external research findings are relevant here. It is useful to explore some of these issues specifically for agricultural research as it is typically the largest and most organized sector (see Table 3 and boxes on individual countries). It is also the sector that is the best documented and where there has been some preliminary analysis of the specific factors mentioned earlier.

Jordan

With annual increases of 4.1% in GDP over the last 5 years, Jordan has a growth record that compares very favourably with other developing countries. The major contribution to GDP is from the services sector (64%) and the two main productive sectors are mining and manufacturing (28%) and agriculture (8%). A large part of the country's development effort has been in investment in all levels of education.

Research has developed markedly since the 1950s. Agricultural research, for example, was formally organized in a department within the Ministry of Agriculture in 1958. The University of Jordan was established in 1962 and has undertaken research in arts and humanities, economics and science, agriculture, medicine, and engineering. The Royal Scientific Society (RSS), founded in 1970, has carried out research in economics, industrial applications, solar energy, and construction.

The RSS has an active program of contracting its consultancy and research services to private- and public-sector institutions in Jordan and, to some extent, to other countries in the region. This has enabled it to generate substantial "independent" income. Other important institutions include the University of Yarmouk, established in 1976, which has undertaken research in sciences, social science, and engineering, and the University of Mu'ta, established in 1984.

Since the beginning of the 1980s, research planning and coordination have been the responsibility of a Department of Science and Technology in the Ministry of Planning. A priority of the present 5-year plan (1986–90) is that a working group appointed by the Prime Minister propose an appropriate national organization for S&T planning. In addition to providing for increased financial allocations to R&D, the plan also includes as major S&T goals:

- To organize national efforts in the area of social, economic, scientific, and technological information and to develop such information for use in planning;
- To control and organize the process of transfer and import of advanced technology to ensure the transfer of scientific and technical knowledge; and
- To expand cooperation programs and to work for Arab integration in S&T, to increase cooperation with developing and developed countries, and to encourage the establishment of regional and international scientific centres in Jordan.

It has been suggested that a minimum research mass is necessary in agricultural research. Much further work is required on this notion for this minimum will probably vary by kind of research (varietal crop selection, animal disease research, etc.) and be affected by the experience of researchers and their access to external information.

M.E. Piñeiro and E.J. Trigo of the Inter-American Institute for Cooperation on Agriculture (IICA) made estimates for the cost of a minimum module for research on one crop in 1982 and explored some of the implications of this concept. They suggest that a minimum package required annual expenditure of US $500 000 (90% operational expenses; 10% for innovations and equipment). This module included four chief researchers at the MSc or PhD level (3 person years in plant breeding/ agronomy and pest and disease control and 1 person year equivalent in socioeconomics and other specializations) with support costs, training, and so on. This cost was then compared to what might be available for research based on a percentage of agricultural production. In comparing this estimate to 1982 budgetary levels for agricultural research, only the larger countries would be in a position to finance a broad coverage (multiproduct) research infrastructure.

They looked at six basic commodities (wheat, rice, corn, potatoes, cassava, and beans) in Latin America and the Caribbean. Using their estimates of minimum annual expenditures, they estimated that the production value of individual crops was high enough to cover the minimum costs in only 40 of 114 possible crops programs if one assumed research expenditures equivalent to 1% of the crop value. In many cases, research expenditures on a crop are much less than 1% of the value of production of that crop. Of 17 "small countries," there were only 10 where the minimum research module for even one crop could be justified on the basis of these figures.

Later analysis was undertaken by W.K. Gamble and E.J. Trigo of the International Service for National Agricultural Research (ISNAR) on seven prime crops in 38 small countries in Central America, the Caribbean, and Africa (and presented at a workshop on agricultural research policy and organization in small countries in 1984). By using the same module but varying the costs, they arrived at an annual minimum research expenditure of US $309 000/ crop. They compared this to four different percentages of value of production being allocated to agricultural research: 0.5, 0.75, 1.0 and 2.0% (Table 4). According to their analysis "in Latin America and the Caribbean, of 102 country–product combinations for maize, rice, cassava, cotton, beans, and potatoes, in only 10 cases is the economic base large enough to support a minimum research effort if 0.5% of the value of production is spent on research. If expenditures are increased to 0.75% of production value, 14 cases would be viable, and at 1.0% (double the actual expenditures for 1980), the minimum research module could be supported in 16 cases."

According to Gamble and Trigo's analysis, "the African situation is not much different. Out of 105 cases covering five products, four combinations are feasible at the 0.5% level, 10 at 0.75%, and 11 at 1.0%. According to these calculations, not one of the countries examined could support sorghum research at the defined minimum level, only one could support maize research, and in two cases a minimum effort in rice would be viable. In cassava, there is a better situation, especially at the 0.5% and 1.0% level, where six and seven cases, respectively, are viable."

Admittedly, the concept of a minimum research module is still an artificial construct, and the actual levels required for crop research programs in different countries may vary widely. This kind of analysis does suggest, however,

Table 4. Country–product combinations (%) generating enough economic value to support a minimum research module, the Caribbean, Central America, and Africa.

	Maize				Rice				Cassava				Cotton				Beans				Potatoes/ sorghum[a]			
Subregion/country	0.5	0.75	1	2	0.5	0.75	1	2	0.5	0.75	1	2	0.5	0.75	1	2	0.5	0.75	1	2	0.5	0.75	1	2
Caribbean																								
Barbados																								
Cuba				X	X	X	X	X	X		X	X								X				X
Dominican Republic					X	X	X	X												X				
Grenada																								
Guadeloupe																								
Guyana					X	X	X	X																
Haiti				X		X	X	X				X								X				
Jamaica																								
Martinique																								
Trinidad & Tobago																								
Central America																								
Belize																								
Costa Rica					X	X	X	X								X								
El Salvador	X	X	X	X				X					X	X	X	X				X				
Guatemala	X	X	X	X				X					X	X	X	X	X	X	X					
Honduras		X	X	X										X	X	X				X				
Nicaragua				X				X					X	X	X	X			X	X				
Panama					X	X	X	X																
West Africa																								
Benin		X	X	X					X	X	X	X		X	X	X								
Guinea Bissau																								
Equatorial Guinea																								
Gambia																								
Liberia					X	X	X	X			X	X												
Sierra Leone					X	X	X	X																
Togo				X						X	X	X			X	X								
Comoros																								
Cape Verde																								
Reunion																								
East Africa																								
Mauritius																								
Somalia																								X
Central Africa																								
Burundi				X					X	X	X	X												
Gabon																								
Rep. Congo										X	X	X												
Rwanda										X	X	X												
São Tomé																								X
Southern Africa																								
Botswana																								
Namibia																								
Swaziland														X	X	X								
Lesotho																								

Note: X indicates if value is greater than US $309 000. (1 United States dollar [US $] = 1.33 Canadian dollars [CA $].)

Source: Adapted from Gamble, W.K., Trigo, E.J. 1985. Establishing agricultural research policy: problems and alternatives for small countries. In Agricultural research policy and organization in small countries. International Service for National Agricultural Research (ISNAR), The Hague, Netherlands. 41 pp.

[a]Potatoes in Cuba and sorghum in Somalia and São Tomé. Research on beans was not considered for Africa.

Mauritius

Mauritius is one of the most densely populated countries in the world. In spite of its lack of mineral resources, it has achieved favourable economic results since independence in 1968. Over the 1970–79 period, GNP grew annually in real terms at about 7.5%. In 1979, however, the end of the sugar boom and unfavourable climatic factors plunged the country into a severe economic recession. Corrective measures have had some success, and GNP continued to grow at 3.9% from 1980 to 1985.

Before 1968, Mauritius had almost all the characteristics of a monocrop island economy; its main crop, sugar, occupied 92% of agricultural land, accounted for 40% of its GNP, 82% of its export proceeds, and 40% of employment. Since then, the economy has become more diversified with the introduction and rapid development of new economic activities.

Organized research in Mauritius dates back to the establishment of an agricultural station in 1893 to conduct research on sugarcane and food crops. Sugar research has continued to be a major theme, now conducted by the Mauritius Sugar Industry Research Institute (MSIRI), a parastatal institution created in 1953. Research in fields other than agriculture received less attention before independence, but has seen considerable development since then. New institutions have been created, such as the University of Mauritius, the Mahatma Gandhi Institute, the Mauritius Institute of Education, and, more recently, the Albion Fisheries Research Centre and the Sir Seewoosagur Ramgoolam Medical Research Centre, in addition to research carried out in the various ministries.

There has been no overall research-coordinating agency, although a National Research Council has been considered. A step toward the creation of an overall mechanism has been made with the 1985 establishment of the Food and Agricultural Research Council. Agricultural research is at present carried out independently by three institutions: the Ministry of Agriculture, Fisheries and Natural Resources; MSIRI; and the School of Agriculture of the University of Mauritius.

The creation of the Sir Seewoosagur Ramgoolam Medical Research Centre under the aegis of the University of Mauritius should prove to be a major addition to existing health research activities carried out by the Ministry of Health. Other important areas of research have included energy, requiring the efforts of a number of different institutions; social sciences; and education. One novel feature in social sciences is the recent emergence of some research-oriented NGOs, such as the Institut pour le développement et le progrès, which has studied the socioeconomic environment of fishermen, and the Centre de documentation, de recherches et de formation indianocéaniques (CEDREFI), which has started work on regional cooperation and small planters' involvement in agricultural diversification.

that there are serious issues to be addressed in terms of economic levels of research programs.

The question of economies of scale is linked to the notion of the minimum research module but distinct from it. ("Economies of scale" refers to economies within the research process and to the research cost per unit of production.) In a smaller agricultural research system, research investment per hectare will have to be higher than in a larger system to achieve equal effectiveness. One review suggested that research is justified only where at least 100 000 ha is devoted in a particular country to the crop concerned. This would automatically exclude 48 developing countries where *total* arable land for all crops is less than 100 000 ha. A United States Agency for International Development (USAID) document discussing countries in Africa on this basis

divided them into "technology generators" and "technology adaptors" where eight countries were in the former (only three with a population under 10 million) and 22 in the latter group.

The level of investment required for agricultural research will also be affected by agroclimatic differences within countries — the cost of developing productive farming systems for a small country with great agroclimatic variations will be greater than for another country with more homogeneity. V.W. Ruttan of the University of Minnesota has also pointed out that a small nation with a strong research program but a limited agricultural or industrial base cannot capture as high a proportion of the benefits from its investment in basic research as can a larger nation with a more diversified economic base.

The foregoing arguments (minimum research mass and economies of scale) concern the level and type of research activity that could be undertaken in a small country. It is clear that, just as in the case for the small countries in the OECD, small developing countries cannot by themselves solve the whole range of problems they face. They must look for ways to tap into external research programs. This requires adequate access to external information. However, even here there are indications of constraints on small countries. Studies suggest that the greater the investment in domestic R&D, the greater the potential for absorbing and utilizing external research. Estimates by R.E. Evenson and Y. Kislev of Yale University indicate that for a low-income country with average research capabilities, an investment of US $1000 for research performed in other countries located in a similar geographic and climatic zone would produce annual benefits of US $55 000 for the receiving country. If the recipient country had no domestic research capabilities, the annual benefit of the same investment would be only US $1700. These figures obviously argue for the importance of achieving a minimum level of investment in agricultural research to ensure ability to benefit from advances in knowledge and technology being generated elsewhere.

Toward an R&D Strategy

This analysis, although based on assumptions that are complex and controversial, does serve to underline that the capacity of small developing countries to generate the technology and knowledge they require is severely limited. Further work and extension of the analysis to areas other than agriculture is required. The amount of resources that can be devoted to research *is* limited by size and the importance of overall production. The demands placed on the research system are much less so. The question of size has not often been addressed explicitly in countries' decisions on their R&D activities. Clearly, it has always been present as an implicit factor in allocating limited funds and trying for the greatest possible effect from these. Some of the key areas that require attention include the following:

Research or Borrow

Countries have major decisions to make as to what they should attempt to develop with their own research and what can be "borrowed" from external work. This choice suggests that small countries should probably focus on applied research tailored to particular national needs that are not likely to be covered by "importable" research. Clearly, many small countries are already pursuing this strategy. It also emphasizes the importance for these countries to have adequate capacity to undertake policy research to examine their investment decisions in general and, in this case, their S&T or R&D options.

Concentration

Countries have to consider how many research programs can be supported from the resources available for R&D and whether minimum critical requirements for productive research can be met.

Benefits from External Research

There are a number of options available to ensure that countries get the most out of research and information available elsewhere:

Best Possible Information Countries that are severely constrained in their own research require access to good information on activities and, particularly, the products of research undertaken elsewhere. The ability to assess this information for its applicability and usefulness in a particular national context itself requires considerable training and research experience. Information can be obtained in part through formal information systems, of which a number exist under regional and international auspices, and requires a national ability to access. But information is also available through the "invisible" colleges — researchers exchanging information at conferences, through networks and so on, which requires an active research participation — even if only in a narrow area of a broader field.

Costa Rica

The Costa Rican economy experienced substantial growth from 1950 to 1979, a period marked by extensive diversification and modernization of the productive sector and institutional development. In 1959, industrial production accounted for 13% of GDP; this rose to 20% by 1975 and 24% in 1986. Costa Rica suffered severely from the recession in 1981 and 1982, part of the "crisis" that forms the background to all discussion of the economic scene of the 1980s in Latin America, and it is now facing the challenge of restructuring and reorienting its economic development.

The area of S&T has been explicitly recognized as having a major contribution to make to development. In 1972, the Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT) was created to promote and coordinate S&T policy. In 1980, a department for this area was added to the Ministry of Planning and Economic Policy and, in 1986, the government created a Ministry of Science and Technology. The national program for S&T, part of the national plan for the period 1986–90, sets goals to enable the country to use scientific and technological development to accelerate export-led economic growth in the next 20 years. These include incentives for productive enterprises to undertake more R&D, which appears to have been limited up to now. The government is also borrowing US $20 million from the Inter-American Development Bank for S&T expenditure.

A study undertaken in the early 1980s identified 13 institutions involved in research (including universities, a national technology institute, and the ministries of agriculture and health). Research in universities accounted for 47.6% of total funding, government research centres for 42.8%, and private research for 9.6%. Government research played a significant role in agriculture and health. Private research was working primarily in two areas — agriculture and social science. In agriculture, the relationship between research and production is more visible than in other areas. Growers' associations have, in several cases, decided to set up their own research facilities and programs (e.g., ASBANA in banana production). In other cases, they fund research through government research centres, e.g., the coffee growers through OFICAFE. The government hopes that these close relations between research and production can be encouraged for industry as well.

The Central American region, of which Costa Rica is part, has some experience of regional research institutions. In spite of the major factors limiting the scope and possibility of cooperation in the region, a certain institutional base was established, and three or four institutions, such as the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), are concerned with research.

Support from Multilateral Research There exists a vast array of international and regional institutions that play a role in supporting developing-country research institutions. A survey of these (see *Searching 1985*) showed that they accounted for an annual research budget of more than US $400 million. Some, such as CATIE in Central America, exist particularly to provide services to a network of national research efforts in small countries. Others have a much wider clientele and may need to be encouraged to work more in support of small-country research (e.g., the institutions of the Consultative Group on International Agricultural Research) (CGIAR). The conclusions of the 1985 CGIAR study of potential address this need explicitly.

Support from Other National Research A number of countries continue to rely heavily on links with countries in the North — often as a continuation of relations established under external support to research. All too often, however, these links do not survive the end of a "project " under which assistance was granted. There are also enormous, partly untapped, opportunities for South–South collaboration between countries of a similar size through networks and information on research such as in the Southern African Development Coordination Committee (SADCC) subject networks in Southern Africa. In part, also, these South–South links may be those of smaller countries benefiting from research in larger developing countries facing similar problems.

The limited resources available to small developing countries may make them particularly interested in obtaining external funding from donors for R&D. With heavy reliance on external support for research, small countries risk being vulnerable when donor agencies may, sometimes unconsciously, determine research priorities or at least decide which of a range of priorities actually receives funding.

To alleviate some of these dangers, developing countries, and perhaps small countries in particular, need to have a clear view of the role they expect research to play and the priority areas in which they wish it to be undertaken. Some overall coordination of national research, and of external support to research, seems required. IDRC has tried to be mindful of these problems in contributing to small country research activities. Some recent support to small developing countries is described in the following.

The Fruits of Research

The International Development Research Centre (IDRC) has been investing in the inventive potential of the Third World for the past 17 years. It has had the pleasure of assisting in the training of thousands of young researchers and has witnessed the production of innumerable scientific articles and reports. Supporting this extremely varied creative effort, in a whole range of situations, has been an immense and exciting responsibility.

IDRC has also been taking another responsibility: seeing to the dissemination and application of the valuable results achieved. A particular variety of plant is found to be drought resistant. A new kind of pump can be installed and kept in repair by the local villagers. Bamboo is used to reinforce mud-brick houses, making them earthquake resistant. It may even be that farmers in the vicinity of the research station have already got their hands on the improved seeds, teams of women from a local nongovernmental organization (NGO) have learned how to make and install the pump, or that the government has introduced new construction standards. That's all very well, but there are millions, tens of millions of families in dire need who sometimes die before the benefits of the improved grain variety, the pump, or the reinforced roof ever reach them.

IDRC has become a master in the dissemination of information to researchers. It has used cooperative networks, computer communications, bulletins, seminars, and specialized information centres. It has also succeeded in focusing the best minds of several countries on specific topics. The dehuller, a mechanical device for removing the unpalatable husk of various food grains, is a good example. The variety of names under which it appears corresponds to a whole series of models adapted to local needs: the CRS minidehuller in Gambia, the ENDA minidehuller in Zimbabwe, the RIIC dehuller in Botswana, and the SISMAR dehuller in Senegal.

If the head of a research project becomes a government minister, it certainly increases the likelihood that the results will be applied, and that is something that does happen. But not all project leaders rise to such a high level of decision-making. On a more systematic basis, IDRC helps scientists to set up constructive relationships with a variety of people who enhance the value of results: producers' and entrepreneurs' cooperatives, NGOs, and other donors.

IDRC is itself a laboratory for research into the best ways of putting research at the service of development. Today, it approves projects whose legal contracts contain clauses that would not have been necessary at the time it first began making grants. More and more projects now have clauses covering the sharing and use of royalties. Generally, IDRC sees to it that the payments it is entitled to receive are instead used to reduce the costs of products resulting from the research. Some projects include allocations to help small businesses or cooperatives start turning out new products. In the social sciences, researchers engage in systematic dialogue with the media and decision-makers. Finally, IDRC is working increasingly closely with other donors and institutions that can collaborate in financing pilot plants and then take over to fund large-scale operations for the adoption of new technologies.

This edition of *Searching* briefly describes some of the research projects for which IDRC approved funding last year. In keeping with the theme of small

countries, part of this section covers research activities in countries with less than 10 million people, and another section describes those projects in the larger countries that were approved by IDRC in 1987.

Support for Small Countries

Every year, IDRC finances a large number of research activities in countries with less than 10 million people. In Africa, which is a priority region, more than half the countries fall into this category. All of the Central American countries except for Guatemala have less than 5 million people. Numerous newly independent countries in the Caribbean and the South Pacific have added dozens of microstates to the Third World. Even in Asia, Bhutan and Laos are among the developing countries that can be classified as small.

How Refugees Settle In

Mozambique, Tanzania, Kenya, Ethiopia, and Sudan form a chain of contiguous East African countries, each with more than 10 million people. The extreme eastern horn of the continent, however, is occupied by a geographically large arid country with less than 6 million people: Somalia.

A dramatic example of the drastic fluctuations that can occur in a small country, Somalia has experienced a 20% increase in population in the past decade. Since 1977, 1 million refugees have chosen to migrate there.

The country is poor, 25% of the children die before the age of 5, and only 13% of its land can be cultivated. The presence of 1 million refugees in need of emergency assistance constitutes a major problem. Grain has to be imported to feed these people, who are allowed to cultivate only small plots. This adds to the foreign debt. The demand for firewood has led to the disappearance of all the trees within 40 km of the oldest camps. Overgrazing by the refugees' herds, which are increasing, may well do irreversible ecological damage. Huge numbers of plastic buckets and shoes that were given to the refugees have been resold in local markets and have destroyed artisanal manufacturing. Along with these problems, camps located near the principal cities are turning into suburbs, and certain small towns would disappear if the refugees were to go home.

An inquiry into the socioeconomic integration of refugees and their interaction with local communities has become absolutely essential now that the Somali government has accepted that these foreigners aren't likely to go away soon. IDRC's Board of Governors agreed to finance such an inquiry and it will be carried out by Haqabtir, a Somali NGO specializing in assisting refugees. The results should increase the likelihood of the government basing its policies on knowledge of the actual situation of displaced people rather than on unfounded speculation.

This research is part of a series of IDRC-supported studies on refugees in Thailand, Botswana, Lesotho, Swaziland, and Tanzania. Last year, IDRC also undertook to support an in-depth study of conditions created for the million people whom the Ethiopian government resettled in the south of the country during the 1983–85 drought.

Precambrian Water

None of the countries immediately to the south of the Sahara Desert, referred to as the countries of the Sahel, has more than 10 million people. Like the others, Mali has been severely affected by drought. Even in normal times, only 8% of the population gets its potable water from pumps. AMRAD, a Malian NGO, will test a plastic manual pump developed by an IDRC-funded research program in Africa and Asia.

Before the 47 shallow-well pumps imported from Malaysia are installed, the head of the project and two AMRAD technicians will go for training in Kuala Lumpur, the capital of Malaysia. Although

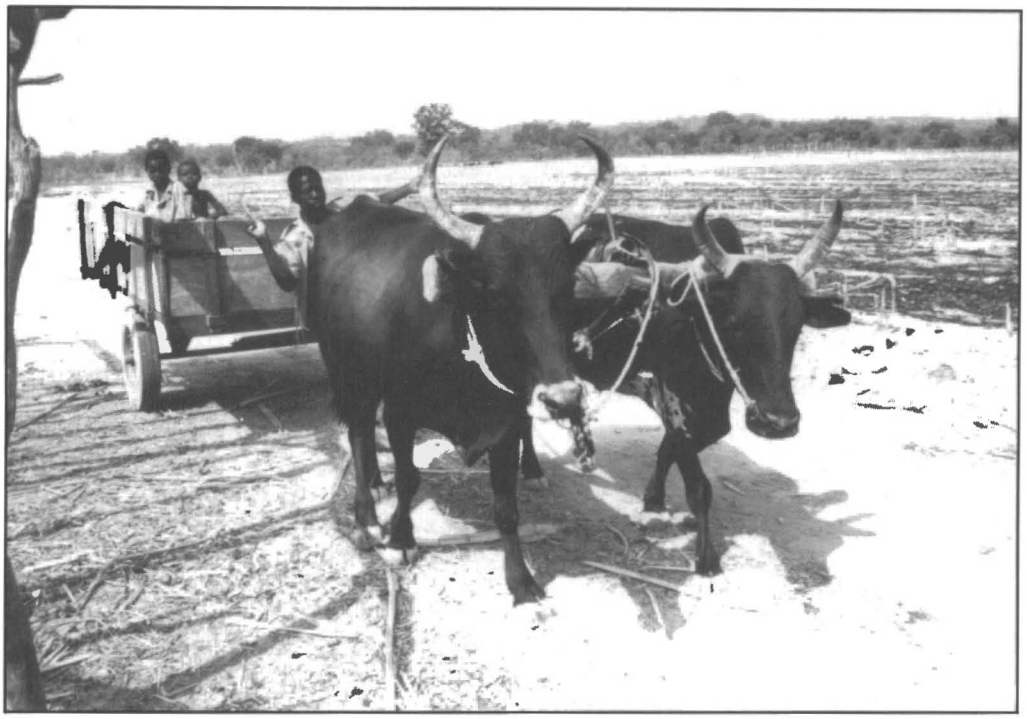
the Tombouctou area of Mali where the pumps are to be tested has been harshly afflicted by drought, water can be found quite close to the surface there because of the proximity of the Niger River. In neighbouring southwest Niger and in 80% of Burkina Faso, on the other hand, deep wells have to be drilled. This is done in the African precambrian bedrock whose cracks are often full of water. Each borehole, however, costs about $10 000. In collaboration with the University of Quebec in Chicoutimi and Montreal, researchers from Burkina Faso and Niger will take samples from existing boreholes and analyze the geological environment to determine the characteristics of high-flow boreholes. The results of these studies should make it easier to identify the best drilling sites, thereby saving millions of dollars.

The Systems Approach

During the droughts of the 1970s and 1980s, the small countries of the Sahel were threatened by a serious loss of their territory to the encroaching desert. Some of them considered quite simply giving up enormous areas. Others tried to make the desert flower again. Still others tried to build up their more climatically reliable areas, as in the case of southern Mali.

Last year, IDRC renewed its support for the development of new cropping systems for the farmers of southern Mali. Since 1979, a team from Mali's Ministry of Agriculture has been working in three villages: Gladié, Monzondougou, and Sakoro. Here they train Malian experts in what is referred to as the "systems approach" to research on agricultural production systems.

With the systems approach, agriculture is viewed as a whole. Specialists in the field begin by studying the full range of activities of a group of farmers. Using what they know about the small farm environment, they make diagnoses and identify any production



A sure sign of improvement of a farmer in south Mali: a powerful team of traction animals.

constraints. Then they work with the farmers on their small plots and test out new packages of agricultural methods.

In the poor village of Sakoro, Malian specialists using the systems approach have been able to increase corn production from 0.5 to 2.5 t/ha. As late as 1980, the village had no draft animals, manure, or fertilizers, and produced no cotton, a crop capable of generating income for the purchase of oxen or fertilizers. By 1985–86, more than a third of the farmers owned a pair of oxen. Together with experts working on a research project into the use of local fertilizer resources, the Malian team also demonstrated the effectiveness of natural phosphates, among others, in growing cowpeas. This enabled farmers to earn more from better fed animals.

Increased incomes in the three pilot villages that participated in the farming systems research program in southern Mali have encouraged neighbouring villages to adopt the same systems. This useful research is only one of numerous activities funded by IDRC and coordinated by the Réseau d'étude des systèmes de production en Afrique de l'Ouest (RESPAO) at Ouagadougou, Burkina Faso. Last year, IDRC also agreed to fund the network's coordinating office and information system there. The network also disseminates to several small countries research results from the important International Institute of Tropical Agriculture (IITA), located in nearby Nigeria. Thanks to several networks of research projects, IDRC contributes in the disseminating of results to small countries from the international research centres and large countries such as Nigeria and China.

A Boost for Entrepreneurs

Halfway through last year, IDRC agreed to fund the information and documentation service of the Fédération des Chambres de commerce de l'Afrique centrale (FCCAC), based in Brazzaville, Congo. The federation brings together the 11 countries of Central Africa, three of which have fewer than 1 million inhabitants: São Tomé and Principe (108 000), Equatorial Guinea (373 000), and Gabon (997 000). The information bulletin, lists, and technological bibliographies that it has already made available will enable the 11 320 commercial interests (such as companies and cooperatives) listed as active in the region to gain access to various kinds of information essential to commercial enterprises, especially agroindustry.

The all-too-few African entrepreneurs upon whom several countries are basing their development strategies need the support of competent staff. In Abidjan, the Centre interafricain pour le développement de la formation professionnelle (CIADFOR) has received IDRC support to establish a network for gathering information on the experiences of West Africa's 19 French-speaking countries in the field of vocational training. Only three of them have more than 10 million inhabitants. The network will enable employers' and workers' organizations to mobilize African resources for the training of personnel in industry, trade, the hotel business, and agroindustry.

Processing Grain Mechanically

In the West African country of Gambia, a small country with a population of 748 000, artisans have begun building dehullers for millet and sorghum. To begin with, they were sent a prototype from Canada. They modified it and produced a dozen. One of these was sold to an entrepreneur whose mill did so well that he now wants to buy a second.

The IDRC Board of Governors supported this experiment in the introduction of technology by authorizing a project for the construction and installation of 13 other minidehullers, run by Catholic Relief Services (CRS), an NGO. Three different workshops will do the manufacturing. CRS staff will conduct a careful study of the operation and

profitability of the 13 minidehullers, each of which will be installed in a different small mill. The experiment has the support of the Women's Bureau of the Gambian government, which has already set up about 20 mills.

At the same time, the Institute for the Study and Application of Integrated Development (ISAID), a Canadian NGO, will install three Gambian-made minidehullers in mills in Niger. (The community-built mills are located in one small town and two villages.) The head of the ISAID project is a Canadian. She has worked closely with the multidisciplinary team in the town of Filingué where the first minidehuller will be set up. Researchers have identified grain dehulling as the bottleneck in food production. In 1982 in Niger, there were 1430 grain mills, but not a single dehuller.

Dehulling and Self-Sufficiency

With a population of only 1.1 million, the Southern African nation of Botswana now relies on a number of local mills to produce sorghum flour. This has reduced its dependence on imports of processed grains from South Africa. A basic element of each of these mills is one or more large-capacity dehullers. This small country has acquired such a mastery of dehuller manufacture that it has been exporting the machines to several other surrounding countries, including Zimbabwe.

Zimbabwe is also well able to manufacture dehullers, specifically minidehullers. Last year, IDRC made a final grant to an NGO, ENDA-Zimbabwe, before the Canadian International Development Agency (CIDA) began the funding of a large-scale operation for disseminating dehuller technology through 40 mills. The dehuller will also make an appearance in Zambia where the Small Industries Development Organization (SIDO) will install it in three community mills. In Tanzania, an organization by the same name has already demonstrated the profitability of the dehuller in a number of mills. Tanzania's SIDO has also received IDRC funding to produce instruction manuals in Swahili. The hope is that these will considerably increase the machine's appeal to entrepreneurs and consumers.

Mothers and Researchers

The South Pacific is dotted with microstates whose populations are distributed among a number of small islands. Some of the large Southeast Asian states also include thousands of isolated island communities. The women on several of these islands are not yet aware of it, but they will soon be in possession of a tool that has transformed other parts of the world. This gift, which is being arranged for them by six teams of academics and government officials, is not something they specifically requested.

Coordinated by a demographer from Singapore and an anthropologist from Malaysia, teams in Fiji, Malaysia, Papua New Guinea, the Philippines, Western Samoa, and Thailand will attempt to pass on the methodology of scientific research to the women. Research professionals have broken down the scientific method into a series of steps for the women to follow.

First, the researchers will study the characteristics of the communities. Then, on their first field visit, they will help the village women to identify from 6 to 10 among themselves to take on responsibility for research. These villager–researchers will agree upon how to proceed after 3 or 4 days' training in data collection and analysis. Each team will carry out surveys of local health conditions while the research professional provides support and guidance. The results of the work of several teams will then be presented in the form of tables and diagrams and shared at a national workshop.

Halfway through the 3-year project, which IDRC approved in 1987, the professional researchers guiding the women will meet to formulate general principles based on the decision-making

process and health priorities of the village women. They will then return the overall results to the women so that they can select the best health strategies for themselves. In the end, the people will have better health services and the professional scientists will have a new methodology for participatory research. Subsequently, this methodology can be used to promote health-related innovations in thousands of island communities.

Cooperative Debt Management

Next to the South Pacific in its wealth of microstates comes the Caribbean. In the north are the Greater Antilles: Cuba, Jamaica, the Dominican Republic, and Haiti. Of these, only Cuba has more than 10 million people. To the southeast are the Lesser Antilles; several still belong to other countries, but a great many of them have become independent in recent years. Seven of them, with populations ranging from 12 000 to 136 000, share a common currency, the Eastern Caribbean dollar, managed by the Eastern Caribbean Central Bank (ECCB). Each of these islands has obtained from 70 to 80 loans all of which have to be repaid. The management of these debts is not centralized and it is difficult for the ECCB to know exactly what is going on with the regional debt.

In 1986, the debt managers of the seven ECCB members (Antigua and Barbuda, St Christopher-Nevis, St Lucia, Dominica, Grenada, St Vincent and the Grenadines, and Montserrat) learned of a debt management system, CS/DRMS, developed by IDRC and the Commonwealth Fund for Technical Cooperation (CFTC). CS/DRMS computerizes the management and analysis of the national debt. It makes it possible to plan loan payments day by day, issue the payments, and determine future foreign currency needs. The program runs on a microcomputer and is supplied free of charge to members of the Commonwealth. To help the seven islands put this system in place, IDRC provided funds to purchase the microcomputers and to help train personnel.

Income from Oysters

In Jamaica, the smallest of the Greater Antilles, IDRC has renewed its support for an oyster culture project so successful that there are now fears the increase in production will depress prices. Some 10 entrepreneurs have adopted the technique developed by the Ministry of Agriculture. There are still, however, serious problems to be tackled. The mortality among oyster larvae, for example, is too high and threatens the profitability of the operations.

Be that as it may, there is now a system for oyster farming and a number of people are anxious to get into the oyster farming business. This new phase of the project affords the Ministry of Agriculture an exceptional opportunity to transfer technology to cooperatives and entrepreneurs. It includes a small fund for granting loans to new oyster farmers.

Old tires and bamboo stalks have been installed in the water for the oysters to cling to. To the great joy of fishermen, fish have returned in great numbers to these places. Plans are also being made to introduce the cultivation of sea moss, based on a system developed in another IDRC-supported project on the island of St Lucia in the Lesser Antilles. All in all, a new marine environment is taking form on the coasts of Jamaica. The government is already thinking of it as an export industry that can provide Jamaicans with jobs of a different kind than the large number provided by the tourist hotels.

Farming Suited to Each Hill

Whether it be on Jamaican hillsides or the western Canadian prairies, the price of viable agriculture is constant adaptation. Unforeseeable genetic mutations create new breeds of insect pests, contaminated matter introduces unknown diseases, and the demand for a crop collapses. No production system is good for all time. Nowadays, if

production systems are to be constantly adapted, they need the backing of research and that research must be targeted on farms.

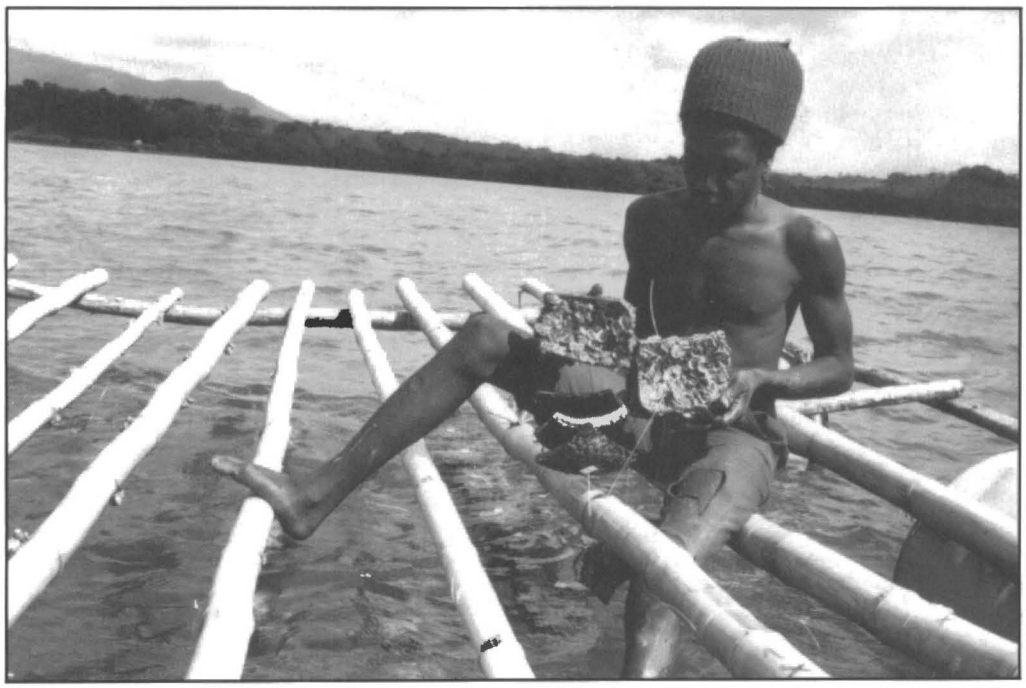
In the course of research into production systems on 2500 farms in the Guy's Hill and Watermount regions on the western tip of Jamaica, researchers have already produced varieties of vegetables with a higher yield. They have also demonstrated that the introduction of fruit trees stabilizes the soil on the hillsides. Much of their success results from their open-mindedness in allowing themselves to be guided by the farmers on the question of which crop combinations or sequences are worth retaining. IDRC will continue to support their work on developing systems for use by hillside farmers that combine grains, vegetables, and trees.

Similarly, on the other side of the Caribbean, in Costa Rica, scientists from the University of San José will experiment with various systems that combine crops, trees, and livestock. Their introduction will be suggested to 2500 families settled on new land in the north of this small Central American country. The Jamaican and Costa Rican researchers will have the opportunity to collaborate with IDRC-supported production systems specialists in other countries of the region.

Biological Control

Costa Rica is one in a chain of seven small countries that link North and South America. A number of them are experiencing severe social tensions and even armed conflict. This does not stop research, but neither does it help it.

In Nicaragua, immediately to the North of Costa Rica, biochemists have already begun using *Bacillus thuringiensis* (Bt) bacteria to combat pests that destroy corn and vegetables. In 1986, Nicaraguan agricultural producers used 280 t of Bt, half of it imported. Current demand is, however, 1400 t. It also seems that the



In Jamaica, entrepreneurs and cooperatives are now eager to get into oyster culture, using an economical technology package developed with IDRC support.

type of Bt imported is not fully adequate and that its efficiency in a hot humid climate cannot be guaranteed. IDRC has, therefore, given its support to a joint research project involving Canadian biochemists at the University of Western Ontario and Mexican specialists from the Centro de Investigación y Estudios Avanzados del Instituto Politécnico Nacional to help Nicaragua identify the most useful breeds of Bt and develop methods for the industrial production of this living insecticide. A consortium of Canadian NGOs, guided by Inter-Pares, has undertaken to fund a factory for the production of Bt in Nicaragua when that stage is reached.

Agriculture in a State of Shock

In South America, the only countries with populations of less than 10 million — Bolivia, Ecuador, Paraguay, and Uruguay — run in a chain from the northwest to the southeast of the continent. In Paraguay, which has long been an isolated enclave both politically and geographically, more than half the labour force works in farming. In the 1960s and 1970s, its agricultural sector had the highest rate of growth in Latin America. Soybean production, for example, went from 10 000 t in 1967 to more than 700 000 t in 1977. Strong international demand, easy credit, an enormous program that distributed land to 80 000 families, and the clearing of large Brazilian-owned farms all fueled this explosive growth.

Then, in the early 1980s, crisis struck. Collapsing prices coincided with an increase in production costs, a reduction of credit, the suspension of land distribution, and the impoverishment of the new land.

More than half the agricultural enterprises in the country have less than 10 ha of land and the small-scale farmers are unable to cope with this situation. Things were made even worse because, as researchers at the Centro Paraguayo de Estudios Sociológicos showed, state policies failed altogether to meet the farmers' needs. This research, which IDRC's Board of Governors has agreed to continue supporting, will enable a large group of NGOs, cooperatives, and producers' associations to work closely with government officials in formulating policies better adapted to the present context. A similar project in neighbouring Uruguay, which is also in the throes of a severe economic depression, deals with rice and wheat, products for which the market is stagnant.

The following section covers some of the research projects IDRC agreed to support in 1987 in countries with populations of more than 10 million. The range of problems and, fortunately, of results is on a par with the size of the countries concerned.

Solutions to Match Problems

Although many small countries are having serious difficulty in paying back their foreign debt, one hears much more about the problems of the larger countries, but that is hardly surprising. The three largest countries in Latin America — Argentina, Brazil, and Mexico — account for 25% of Third World debt.

Economists for the People

Economists in Argentina, Brazil, and Peru came up with novel plans to combat inflation: the Austral, Inti, and Cruzado plans. The Cruzado Plan is in ruins, victim to the hesitations of the politicians involved. The Inti Plan has been swept away by the convulsions shaking Peru. In Argentina, the Austral Plan has broken the back of inertial inflation (that part of inflation attributable to an inflationary psychology), but structural inflation, caused by intrinsic deficiencies in the economy, persists. IDRC supported several of the economists who designed these plans.

There is a great deal to be learned from these experiments and they continue to be studied. But no one any longer supposes that there can be a rapid, painless remedy. If they are to recover,

the economies of Latin America will have to go through painful restructuring based on social consensus. Such a consensus can only come from national discussion drawing upon original ideas. For a number of years, IDRC has supported the efforts of numerous local economists to come up with constructive ideas. Last year, it continued its support for the work of several groups of economists based in universities or independent institutes. Two such groups, the Corporación de Investigaciones Económicas para Latinoamérica (CIEPLAN) in Chile and the Group of Analysis for Development (GRADE) in Peru, are active in disseminating the results of their work and encouraging national discussion. CIEPLAN, which has been called the most important political economy research institute in Latin America, if not in the Third World, has instituted a running dialogue with the economic press in the form of a continuous seminar on popular economic journalism. Members of CIEPLAN travel around Chile to speak with entrepreneurs, peasants, and workers. They have recorded economic discussions on video cassettes that circulate throughout the country outside the official channels. Each month, the ideas of the CIEPLAN researchers are also put before the Chilean and Latin American public in the form of newspaper and magazine articles.

IDRC will maintain its support for several other economic research programs in Bolivia, Colombia, Costa Rica, and Nicaragua. It has also taken a leadership role in the creation of a major program to support economic research in sub-Saharan Africa. The program allows for meetings and exchanges with Latin American economists.

Job Creation

Along with debt, one of the biggest concerns of Third World countries continues to be job creation. Things could hardly be otherwise in countries where 40–45% of the population is under the age of 15.

This creation of new jobs must occur at a time when industrialization requires countries to take an increasingly difficult leap forward, but creates almost no employment. One route that has long been taken is the local manufacture of previously imported products — import substitution. This approach also enhances the value of resources unique to the countries of the South. Peru, for example, has several sources of important natural colorants. These include cochineal, a superb carmine (red) colorant made from insects that feed on cactus.

In 1986, IDRC funded joint research by Simon Fraser University in British Columbia and the Instituto de Investigación Tecnológica Industrial y de Normas Técnicas (ITINTEC) to improve the rate of extraction of carmine dye from cochineal. Rates as high as 25% have been attained, but in Peruvian enterprises it is only 15%. A new grant from IDRC will allow construction of a pilot plant that uses the new procedure. The new technology will be transferred to industry by putting the plant up for auction. This should enable the funding agencies to get back some of the money committed. Similar joint research on textile dyes will be done by Sherbrooke University and the Pakistan Council of Scientific and Industrial Research (PCSIR).

A project involving the development of microprocessors for the digital control of machine tools may well turn the Institut d'ordinique du Québec (IOQ) into a research centre specializing in the development of industrial systems based on microprocessors. Its partner is an industrial research company, PACE, in Hyderabad, India. There are even plans for an association between the Fondation IOQ (a nonprofit organization) and PACE to manufacture and market electronic modules designed to resist sudden drops in voltage and dusty or humid environments.

Not all research projects linking Canadian specialists and their Third World colleagues involve royalties

payable to IDRC. In Peru, for example, IDRC-supported research has already found ways of making houses built of adobe (dried earth bricks) far more resistant to earthquakes. Last year, IDRC made another grant to Peru to improve traditional quincha houses, usually built of bamboo plastered with dried mud. The Canadian partner of the Pontificia Universidad Católica, in Lima, is the Technical University of Nova Scotia, in Halifax.

The Multiplier Effect

One of IDRC's criteria for funding is the regionalization and internationalization of the research results. IDRC prefers to select projects whose results could be useful to several countries. In the case of China, this effort to multiply the benefits takes on its full force. This is why a large share of the research funded in China is approached from an international angle. In fact, IDRC is helping China to help other developing countries.

At the beginning of 1988, China will inaugurate a completely new Sino-Canadian Mariculture Research and Training Centre at Qingdao on the coast of the Yellow Sea. The ancient Chinese science of raising ocean fish in captivity will be developed there and the institution will take in students from developing countries. China is extremely proud of this trilateral North–South–South operation that allows it to advance scientifically at the same time it helps other countries.

The raising of giant prawns and mullet has been practiced extremely intensively in tens of thousands of hectares of pens on the shores of the Yellow Sea and the China Sea. Moreover, there has been explosive growth in the farming of "haidai," marine algae used as a food. It seems, however, that the limits of the mariculture systems have been reached and losses caused by various diseases are increasingly serious. The Chinese specialists hope to restart mariculture on a new basis by combining algae farming with shellfish culture. This new marine polyculture will create a more balanced marine environment that, in turn, will decrease the risk of shattering epidemics that occur when too many individuals of the same species are crowded together.

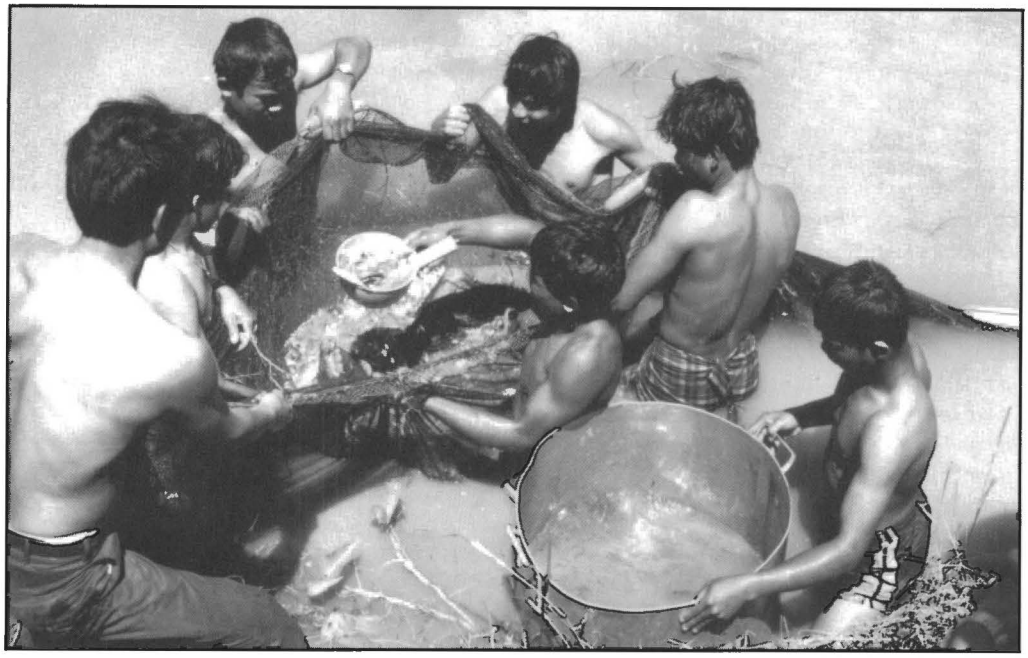
The funding authorized by IDRC's Board of Governors will contribute to new patterns of marine polyculture. At the same time, funds have been allocated for the production of instructional materials and to introduce teaching staff to modern teaching methods.

IDRC–China research cooperation is producing excellent results in the area of fisheries. These include the development of a drug-hormone kit used to induce several species of fish, mainly carp, to breed, thereby improving the reliability and quantity of the supply of fry for fish farming. The technology is already marketed in Canada by Syndel Laboratories, in Vancouver, and talks are under way to have the kit manufactured and sold in China by the Chinese Ningpo Fish Hormone Factory. IDRC has renewed its support for this research that links the work of specialists at the University of Guelph in Ontario, the University of Alberta, and Zhongshan University, this time in an effort to find out how to accelerate the growth in weight of fish by stimulating the secretion of growth hormone.

Throughout Southeast Asia, aquaculture research is expanding rapidly and IDRC's contributions to a number of countries have been considerable. Among the projects supported in 1987, IDRC increased its assistance to the Asian Fisheries Society based in Manila, the Philippines. A significant grant will enable the Society to fund the work of 30 young researchers from the region.

Fish and Rice

In Thailand, it is the scientists who, at present, are being led by the farmers. For more than two centuries, Thai rice growers raised fish in the flooded paddies. But then new varieties of rice were introduced that had to be sprayed with



In Thailand, an increasing number of farmers are raising tilapia, the aquatic equivalent of chicken.

pesticides to keep their promise of high yields. This led to the disappearance of the rice–fish association. Now, however, fish are again showing up in increasing numbers in the paddies of northeast Thailand. The farmers of the region are the poorest in the country, and they decided on their own to reintroduce the combined cultivation of rice and fish because they used only small quantities of pesticide. A team from the Ministry of Agriculture is conducting a detailed study of farmers' practices. The preliminary results indicate that fish protect rice against disease and pests, and those who grow rice and fish together earn from 50 to 100% more. Dissemination of the rice–fish production system is already being supported by a Canadian NGO, CUSO, and CIDA. The IDRC-supported research project should help to facilitate this activity.

Canada Benefits Too

Some of the IDRC-funded research that links Canadian and Third World researchers leads to a mutually profitable exchange. Last year, IDRC renewed its support to a major program for the improvement of rapeseed, carried on jointly by the Canadian and Chinese ministries of agriculture. In an initial phase, Chinese growers managed rapidly to adopt Canadian-developed varieties, called Canola, which are low in erucic acid (harmful to human beings). One of the priorities of the second phase is to collect native Chinese varieties, which are threatened with disappearance by the rapid adoption of Canadian varieties. The susceptibility of rapeseed to disease continues to be high, and Canadian producers might one day benefit from the introduction of Chinese genetic material. IDRC is also supporting exchanges between researchers from the two largest rapeseed producers (China and Canada) and those in Egypt, Ethiopia, India, Pakistan, and Sri Lanka — all of them countries in which it supports research into other oilseed plants such as soy, sunflower, and sesame.

Wheat and Trees

Another gift that China might eventually make to the world is the Paulownia tree. In just one decade, this fast-growing tree has been planted on 1.5 million ha of arable land in China. Planted in rows in wheat fields, this multipurpose tree increases the yield of wheat by as much as 23%, provides leaves that can be fed to cattle, enriches the soil, and supplies wood. The danger with the popular Paulownia is that it may end up being the only major agroforestry system in China.

Last year, IDRC renewed its support to the Chinese Academy of Forestry, the institution carrying out this research whose results are already benefiting many thousands of farmers. IDRC has also provided funding for courses on Paulownia farm forestry for African, Asian, and Latin American foresters. IDRC staff believe that the introduction of this Chinese tree into Latin America could be highly beneficial. Those attending the courses were also given information about the most recent results achieved by Chinese experts in bamboo research. Bamboo has fed and sheltered people in tropical countries for thousands of years. Last year, to help the Chinese Academy of Forestry disseminate its results, IDRC granted it funds to establish an information centre in Beijing for disseminating world wide the most recent research results on bamboo. Among numerous grants to specialized information centres, IDRC also renewed its support for the International Buffalo Information Centre at Kasetsart University in Bangkok and to the International Network for the Improvement of Banana and Plantain, a decentralized research structure represented on every continent.

Telematic NGOs

It is technically feasible to link up Third World NGOs by computer. It can be done by people who know nothing about computers and the cost is reasonable. Several NGOs are already equipped with microcomputers and the notion of interconnecting them is catching on fast in numerous developing countries.

That is the main conclusion drawn from an experiment conducted by the Instituto Latinoamericano de Estudios Transnacionales (ILET), a Latin American NGO based in Santiago, Chile, with offices in Mexico and Buenos Aires. IDRC has agreed to support the work for a further 2 years. The experimental project also demonstrated that it was possible to coordinate the activities of NGOs based in different countries. All of this can be done while achieving substantial economies in telephone charges. In the next phase, ILET will test new telecommunications software and develop training programs in telematics techniques. ILET's Mexican office will also use the experience acquired to promote the use of Mexican data banks and networks.

In fact, many Mexican customers of foreign data banks fail to use the data banks already in place there or don't know of their existence. This leads to a waste of foreign currency. Moreover, identifying a document in a data bank outside the country in no way guarantees obtaining the whole document. This national project will provide ILET with information that can then be used to facilitate the increased usage and eventual expansion of Mexican information and communication resources.

Marketing the Results

Despite the growing role of computerized networks in the dissemination of scientific and technical information, paper documents are still the major repository of results and are the preferred medium of communication by researchers. Last year, IDRC participated in the training of those responsible for producing scientific and technical publications in Asia and North Africa. It is also helping to support the production of a whole range of vehicles for the dissemination of research results: films, videos, bulletins, pamphlets, and posters.

Research funded by IDRC has demonstrated that people, better than drugs alone, can improve the health status of communities.

Sometimes these are produced as complements to an instruction manual, a training course, and a specialized telematic network to answer users' questions rapidly, all this being part of global marketing operations, such as the one for the polyvinyl chloride (PVC) handpump.

Priming the PVC Pump

In 1987, CIDA combined forces with IDRC to disseminate a simple, inexpensive water pump, developed over 11 years in a series of IDRC-funded projects. The central element in efforts to manufacture, promote, and disseminate the pump will be a completely new centre for research and training in handpump technology at the University of Malaya in Kuala Lumpur, Malaysia.

Projects in previous phases in Asia and East Africa have confirmed that the pump can be manufactured in developing countries using PVC plastic, the kind now widely used in household plumbing.

The PVC pump has been adapted to the different contexts of 11 Asian and African countries. It has been demonstrated that village people can install and maintain it. What has to be done now is to disseminate it among the millions of Third World families who still don't have potable water.

The dissemination strategy that IDRC and CIDA have decided to support is based on training future manufacturers of the pump at the University of Malaya centre. Third World entrepreneurs and NGOs will be invited to obtain manufacturing licences from this centre of excellence in handpump technology, which will be responsible for the worldwide dissemination of the pump.

The end result of this project will be the complete appropriation of the research, manufacture, and marketing of

the pump by the Third World. If it is successful, the project will serve as a model of technological innovation in developing countries.

In addition to the establishment of the handpump centre in Kuala Lumpur, IDRC agreed last year to fund an important experiment in the manufacture and marketing of the handpump by an NGO in Sri Lanka. Again, CIDA is IDRC's partner in this project in which the manufacture and installation will be done by women. In China and Kenya, two experiments in the use of a version of the pump for deep wells (30–40 m) have also been funded. These two countries will benefit from the assistance of Malaysian experts before they, in turn, become centres for the dissemination of plastic handpump technology.

AIDS Children

In Africa, AIDS afflicts women as well as men and, as a result, also strikes babies. Epidemiological studies show that as many as 20% of the population in some regions of Africa carry the AIDS virus. It is now thought that as many as 10% of children will be born already infected by this deadly disease, and what if those who are spared at birth become infected through their mother's milk?

Two projects funded by IDRC in 1987 are designed to elucidate how transmission from mother to infant occurs. The first study will be done in Kenya based on a sample of 100 mothers infected with HIV, the AIDS virus. The mothers were recruited from a hospital where 3% of women delivering babies are carriers. The other study will be done in Uganda where the situation is quite simply catastrophic. In a sample of 1000 pregnant women, 137 were HIV positive. IDRC has also granted funds for the development of an AIDS diagnostic kit by a U.S.-based NGO directed by a Canadian, the Program for Appropriate Technology in Health (PATH).

The Fifth International Conference on AIDS will also draw upon IDRC expertise. The Canadian government has entrusted IDRC with the organization of the conference, to be held in Montreal in June 1989. More than 10 000 participants are expected to attend.

Because of AIDS, many lives will depend upon the success of information campaigns in changing people's behaviour. In the Third World, more than elsewhere, the successful mobilization of the community can achieve more than any technology or machine. This is true not only in the health sector but in many areas.

Last year, IDRC renewed its funding for several projects aimed at developing preventive campaigns with community participation. Some of these projects — such as one on the transmission of two parasitic worms, ankylostoma and ascaris, conducted by Gadjah Mada University in Jogjakarta, Indonesia, and one dealing with a liver parasite at Mahidol University, Bangkok, Thailand — have already involved mobilizing the local population. Community involvement enabled the doctor in charge of the Indonesian project to reach the conclusion that mass chemotherapy, the improvement of health facilities, and education were far more effective in reducing reinfection rates than mass chemotherapy alone. There needs to be follow-up to ascertain how best to ensure the maintenance of good habits.

Whether in health, agriculture, or economics, the hundreds of projects funded annually by IDRC can only achieve their objectives if the target populations feel that the results belong to them. This takes on even greater significance if one realizes that the potential users of this research have little or no income. In pursuit of this goal, IDRC projects increasingly get scientists involved with the local population. In a certain sense, IDRC is the partner, not only of the thousands of scientists who are its immediate associates, but also of the poverty-stricken millions of the Third World who cling to their belief in a better future.

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